addition of manganese or nickel, taking into consideration the consumption to form intermetallic compounds with those elements.

[0035] It is also noted that aluminum, and phosphorus help to reinforce the alpha phase in the matrix, thereby improving the machinability. Phosphorus disperses the alpha and gamma phases, by which the strength, wear resistance, and also machinability are improved Aluminum also contributes to improving the wear resistance and exhibits its effect of reinforcing the matrix when added in an amount of 0.2 or more percent by weight. But if the addition exceeds 2.5 percent by weight, there will be a decrease in ductility. Therefore, the addition of aluminum is set at 0.2 to 2.5 in consideration of improvement of machinability. Also, the addition of phosphorus disperses the gamma phase and at the same time pulverizes the crystal grains in the alpha phase in the matrix, thereby improving the hot workability and also the strength and wear resistance. Furthermore, it is very effective in improving the flow of molten metal in casting. Such results will be produced when phosphorus is added in an amount of 0.02 to 0.25 percent by weight. The content of copper is set at 62 to 78 percent by weight in the light of the addition of silicon and the property of manganese and nickel of combining with silicon.

[0036] A free-cutting copper alloy also with an excellent easy-to-cut feature and with an excellent high-temperature oxidation resistance which comprises 69 to 79 percent, by weight, of copper, 2.0 to 4.0 percent, by weight, of silicon, 0.02 to 0.4 percent, by weight, of lead, 0.1 to 1.5 percent, by weight, of aluminum, and 0.02 to 0.25 percent, by weight, of phosphorus, and the remaining percent, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, and phosphorous in the copper alloy satisfy the relationship $60 \leq X - 3Y + aZ + bW \leq 70$, wherein X is the percent, by weight, of copper, Y is the percent, by

weight, of silicon, Z is the percent, by weight, of aluminum, W is the percent, by weight, of phosphorous, a is –2, and b is –3; and the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase. The eighth copper alloy will be hereinafter called the "eighth invention alloy."

[0037] Aluminum is an element which improves strength, machinability, wear resistance, and also high-temperature oxidation resistance. Silicon, too, has a property of enhancing machinability, strength, wear resistance, resistance to stress corrosion cracking, and also high-temperature oxidation resistance. Aluminum works to raise the high-temperature oxidation resistance when it is used together with silicon in amounts not smaller than 0.1 percent by weight. But even if the addition of aluminum increases beyond 1.5 percent by weight, no proportional results can be expected. For this reason, the addition of aluminum is set at 0.1 to 1.5 percent by weight.

[0038] Phosphorus is added to enhance the flow of molten metal in casting. Phosphorus also works to improve the aforesaid machinability, de-zinc-ification corrosion resistance, and also high-temperature oxidation resistance, in addition to the flow of molten metal. Those effects are exhibited when phosphorus is added in amounts not smaller than 0.02 percent by weight. But even if phosphorus is used in amounts greater than 0.25 percent by weight, it will not result in a proportional increase in effect, rather weakening the alloy. Based upon this consideration, phosphorus is added to within a range of 0.02 to 0.25 percent by weight.

[0039] While silicon is added to improve machinability as mentioned above, it is also capable of improving the flow of molten metal like phosphorus. The effect of silicon in improving the flow of molten metal is exhibited when it is added in an amount not smaller than 2.0 percent by weight. The range of the addition for flow improvement overlaps that for improvement of the machinability. These taken into consideration, the addition of silicon is set to 2.0 to 4.0 percent by weight.

[0040] A free-cutting copper alloy also with excellent easy-to-cut feature coupled with a good high-temperature oxidation resistance which is composed of 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; 0.1 to 1.5 percent, by weight, of aluminum; 0.02 to 0.25 percent, by weight, of phosphorus; one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium, and 0.02 to 0.4 percent, by weight, of selenium; and the remaining percent, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, and phosphorous in the copper alloy satisfy the relationship $60 \leq X - 3Y + aZ + bW \leq 70$, wherein X is the percent, by weight, of copper, Y is the percent, by weight, of silicon, Z is the percent, by weight, of aluminum, W is the percent, by weight, of phosphorous, a is –2, and b is –3; and the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase. The ninth copper alloy will be hereinafter called the "ninth invention alloy."

[0041] The ninth invention alloy contains one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight,